ARTICLE

Comparison of a torsional handpiece through microincision versus standard clear corneal cataract wounds

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PURPOSE: To directly compare intraoperative and clinical parameters using a torsional handpiece through microincision and standard clear corneal cataract wounds with appropriately configured tips and sleeves.

SETTING: Duke University Eye Center, Durham, North Carolina, USA.

METHODS: Cataracts in both eyes of 32 patients needing bilateral surgery were extracted using the OZil torsional handpiece. Tips and sleeve selections were optimized for the incision chosen. Right eyes had cataract surgery using a standard method consisting of a 2.8 mm incision with a 0.9 mm tapered 30-degree bevel Kelman configuration tip with a Microsleeve. Left eyes had cataract surgery through a 2.2 mm microincision using a 0.9 mm miniflared 45-degree bevel Kelman configuration tip with an Ultrasleeve. Intraoperative measurements included cumulative dissipated energy (CDE) and balanced salt solution use. Clinical measurements included preoperative and 1-day postoperative central corneal thickness (CCT), preoperative and 6-month postoperative endothelial cell count (ECC), and preoperative and postoperative anterior segment optical coherence tomography (AS-OCT).

RESULTS: Intraoperatively, the microincision (2.2 mm) group had less CDE use than the standard incision (2.8 mm) group ($P = .001$). Clinical measurements showed less ECC loss at 6 months in the microincision group ($P<.05$). No difference in CCT or AS-OCT findings was detected between groups.

CONCLUSIONS: Phacoemulsification using the OZil torsional handpiece through a microincision with an Ultrasleeve and a 45-degree miniflared tip showed favorable clinical and intraoperative characteristics such as less total energy use and less endothelial cell loss at 6 months. Further studies are warranted to substantiate these preliminary findings.

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The trend toward smaller incisions in cataract surgery continues to be propelled by improving technology and surgical techniques. These advances now allow typical coaxial cataract surgery to be performed through 2.2 mm microincisions. Smaller wounds induce less astigmatism, reduce the need for suturing,[1] and demonstrate stable morphology.[2,3]

Torsional ultrasound, another new technology, provides increased efficiency, decreased energy use, shorter recovery times, and less endothelial cell loss in cataract surgery.[4] Torsional ultrasound is just starting to be paired with microincision coaxial surgery, but little data to support the combination of these technologies exist. We sought to directly compare optimized torsional ultrasound systems through standard 2.8 mm incisions and 2.2 mm microincisions.

PATIENTS AND METHODS

This retrospective review of prospectively collected data was approved by the Duke Institutional Review Board. Cataracts of similar density in both eyes of 32 patients needing bilateral surgery were extracted using the OZil torsional handpiece with the Infiniti Vision System (Alcon). One eye had cataract surgery using a standard method consisting of a 2.8 mm incision with a 0.9 mm tapered 30-degree bevel Kelman configuration tip with a Microsleeve and the Infiniti fluid-management system tubing (standard incision group). The other eye had cataract surgery through a 2.2 mm microincision with a 0.9 mm miniflared 45-degree bevel Kelman configuration tip with an Ultrasleeve and the Infiniti Intrepid advanced fluid-management system tubing (microincision group). Tips and sleeve selections were optimized for the incision chosen. All procedures were performed by the same surgeon (T.K.) through a temporal biplanar clear corneal incision with a similar prechop and/or vertical chopping

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technique for each pair of eyes. Each incision was initiated with entry into the cornea (blade parallel to corneal surface) for 2.0 mm as marked on the keratome. Then the heel of the keratome was lifted (blade perpendicular to cornea) and advanced into the anterior chamber, creating a biplanar incision approximately 2.8 mm in length in each group. The Intrepid ClearCut 2.2 mm dual-bevel metal keratome (Alcon) was used for 2.2 mm incisions. The ClearCut HP 2.8 mm dual-bevel metal keratome (Alcon) was used for 2.8 mm incisions. All wounds had stromal hydration to ensure sealing. The phacoemulsification settings were identical in both groups, with 100% torsional ultrasound, 350 mm Hg vacuum, 100 cm bottle height, and 35 cc/min aspiration rate.

Intraoperative measurements included cumulative dissipated energy (CDE) and balanced salt solution (BSS) use. *Clinical measurements* included central corneal thickness (*CCT*) (Pachette 2 DGH 550, DGH Technology, Inc.) preoperatively and 1 day postoperatively, endothelial cell count (*ECC*) (Konan Noncon Robo Pachy SP9000, Konan Medical Inc.) preoperatively and 6 months postoperatively, and anterior segment optical coherence tomography (*AS-OCT*) (Visante 10001676, Carl Zeiss Inc.) preoperatively, immediately postoperatively, and 1 day and 1 month postoperatively.

RESULTS

Twenty (62.5%) of the 32 patients were women. The mean patient age was 66.6 years ± 11.5 (SD). Six-month postoperative ECC data were available for 22 patients. Table 1 shows the results for the intraoperative parameters (ie, CDE and BSS use) and clinical parameters (ie, preoperative and 1-day postoperative CCT, preoperative and 6-month postoperative ECC) in each group.

Intraoperatively, the microincision group had less CDE use ($P = .001$) than the standard incision group. There was no difference in BSS use between groups. Clinical measurements showed less ECC loss at 6 months ($P < .05$) in the microincision group. There were no differences in CCT or AS-OCT findings between groups.

Linear regression analysis that included data from both groups in a single model showed a correlation between CDE and ECC loss ($P < .05$, $r^2 = 0.133$), CDE and BSS use ($P < .01$, $r^2 = 0.2443$), and the 1-day postoperative change in CCT versus ECC loss ($P < .05$, $r^2 = 0.133$). This trend remained present when each group was analyzed separately (Figure 1). Anterior segment OCT showed no difference in wound morphology between groups at any stage of healing (Figure 2). Anterior segment OCT showed a slight internal wound gape in both groups in the immediate postoperative period and 1 day postoperatively. By 1 month, the internal wound gape had completely sealed. There was no difference in wound leakage between the groups, and no eye had an intraoperative complication.

DISCUSSION

Combining torsional ultrasound through a microincision wound appears safe and effective. The CDE and endothelial cell loss were lower in the microincision group and were the only parameters that showed a statistically significant difference between the 2 groups. Endothelial cell loss in this study was comparable to that in other studies of endothelial cell loss after phacoemulsification.[5–8] Intuitive, but weakly correlated, trends showed increased CDE associated with increased endothelial cell loss and increased BSS use. These trends were present in the 2.2 mm group and the 2.8 mm group. Anterior segment OCT showed good wound apposition in both groups at 1 day postoperatively and complete wound apposition by 1 month. No patient in either group had an intraoperative complication or difficulty with visual recovery postoperatively. To our knowledge, this is the first direct comparison of torsional ultrasound through standard versus microincision clear corneal wounds.

The trend toward smaller incisions was initiated by 2 major advances in cataract surgery: phacoemulsification and foldable intraocular lenses (IOLs). Phacoemulsification has provided the ability to emulsify and aspirate the lens within the confines of the anterior segment. Thus, the incision size has been dictated by the diameter of the IOL optic; the advent of foldable IOLs has minimized that limitation. Smaller incisions have many advantages including less induced astigmatism, faster visual recovery, decreased discomfort, and decreased need for suturing.[1,9–12] Microincision wounds are increasingly used for both coaxial and bimanual phacoemulsification. Although this study showed that only coaxial torsional ultrasound appears effective through a microincision, a bimanual approach using torsional ultrasound could be envisioned. However, questions about wound integrity and structure would have to be addressed.[2,13]

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Table 1. Clinical and intraoperative characteristics.

	Mean ± SD		
Parameter	2.8 mm Incision	2.2 mm Incision	*P* Value
Intraoperative			
Cumulative dissipated energy	6.64 ± 3.82	5.07 ± 3.14	.001
Balanced salt solution used (g)	38.4 ± 20.3	41.1 ± 22.5	.479
Clinical			
Central corneal thickness (μm)			
Preoperative	553 ± 38.0	554 ± 33.9	.927
1 d postoperative	579 ± 50.0	577 ± 43.5	.835
Change	25.4 ± 33.3	23.6 ± 23.3	.802
Endothelial cell count (μm)			
Preoperative	2317 ± 411	2310 ± 414	.879
6 mo postoperative	1979 ± 447	2087 ± 466	.032
Change	−285 ± 226.9	−188 ± 188.6	.044
AS-OCT			

Conventional ultrasound uses longitudinal excursion of the phacoemulsification needle to emulsify the lens. This can produce repulsion of lenticular material from the aspiration port and decrease efficiency. Torsional ultrasound differs from conventional ultrasound because it produces rotational movement at the phaco needle. This rotational movement may provide more efficient cataract removal because there is minimal repulsion of lenticular material and shearing forces are used to emulsify the lens.[4,14,15]

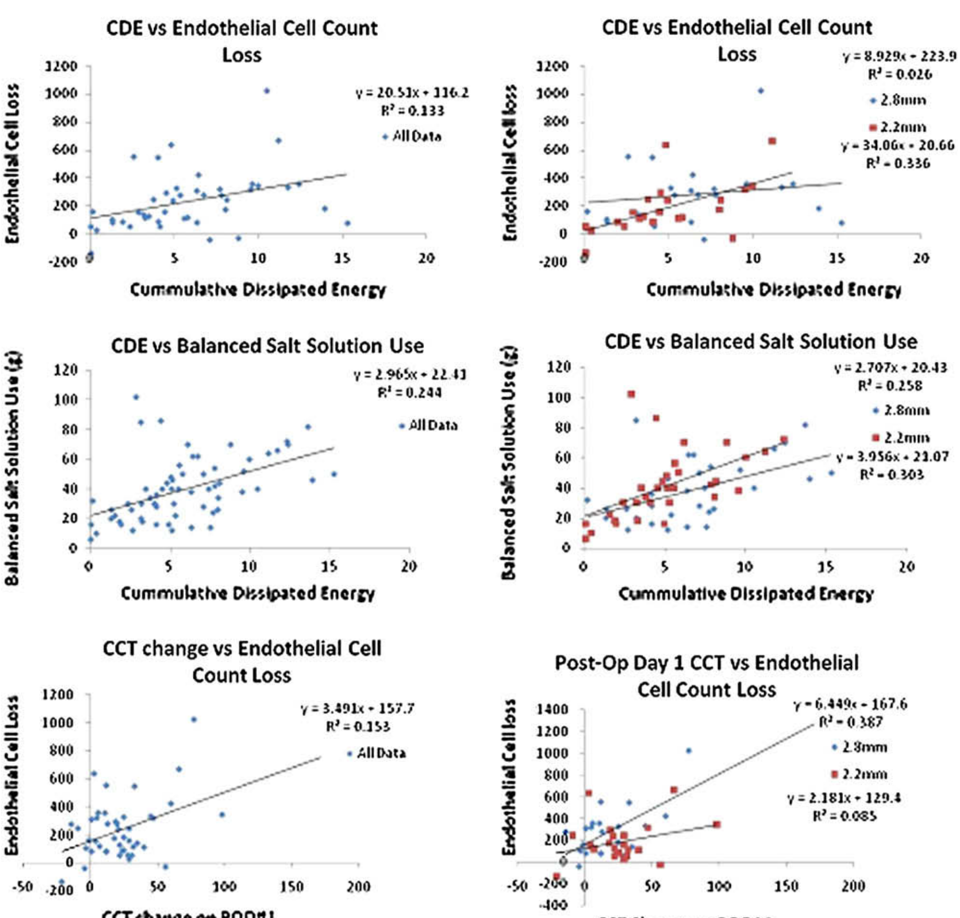

Figure 1. Cumulative dissipated energy (CDE) versus endothelial cell loss, BSS use, and change in CCT. *Left column*: Combined data from both groups. *Right column*: Data separated into 2.8 mm incision group and 2.2 mm incision group.

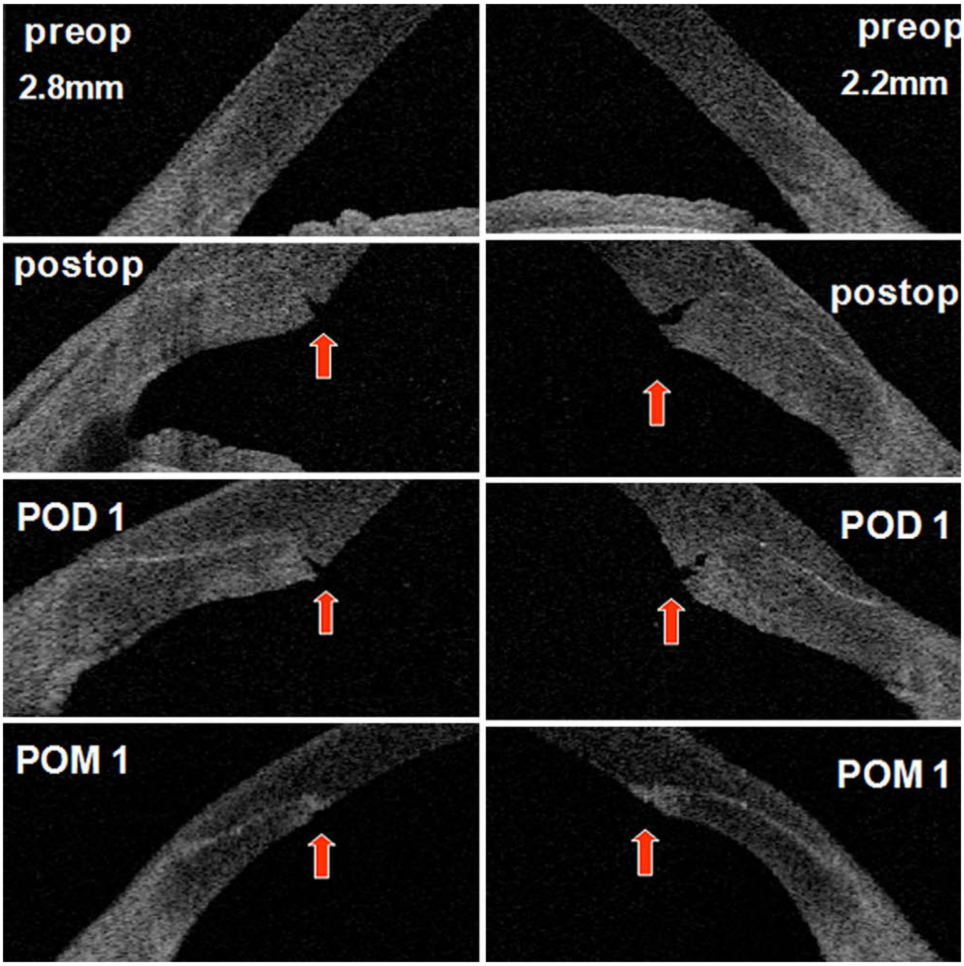

Figure 2. Anterior segment OCTs of both eyes of the same patient before and after cataract surgery. *Left column*: 2.8 mm incision. *Right column*: 2.2 mm incision (preop = preoperative; postop = immediate postoperative; POD 1 = postoperative day 1; POM 1 = postoperative month 1).

A major strength of this study is its contralateral design, which allows direct intraindividual comparison and eliminates the need for matching. However, a potential criticism of this study design is the use of a different tip for each group (ie, 45-degree tip in the 2.2 mm group versus a 30-degree tip in the 2.8 mm group). The various aspects of the phacoemulsification procedure, such as cutting efficiency, anterior chamber fluid dynamics, and BSS use, can be influenced by differences in tip configuration. The tips for each group were specifically chosen to maximize efficiency during cataract surgery based on the surgeon's experience and on recommendations by the manufacturer for optimum performance.[16] Data interpretation should be made with these limitations in mind.

As new technologies are developed and merged throughout medicine, evidence should be sought to support their use. Combining phacoemulsification using the OZil torsional handpiece through a microincision showed favorable clinical and intraoperative characteristics, such as less total energy usage and less endothelial cell loss at 6 months. Further studies are warranted to substantiate these preliminary findings.

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